

DAIRY TECHNOLOGY

VOLUME 2

Dairy Products & Quality Assurance



Shivashraya Singh

Dairy Technology

VOLUME – 2

Dairy Products and Quality Assurance

Shivashraya Singh

Former Joint Director-cum-Dean and Emeritus Scientist
National Dairy Research Institute
Karnal – 132 001, Haryana



NEW INDIA PUBLISHING AGENCY

New Delhi – 110 034



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, LSC Market

Pitam Pura, New Delhi 110 034, India

Phone: + 91 (11)27 34 17 17 Fax: + 91(11) 27 34 16 16

Email: info@nipabooks.com

Web: www.nipabooks.com

Feedback at feedbacks@nipabooks.com

© Author, 2014

ISBN: 978-93-83305-09-4 (Volume -02)

ISBN: 978-93-83305-08-7 (Volume -01)

ISBN: 978-93-81450-99-4 (Set)

All rights reserved, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher or the copyright holder.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author/s, editor/s and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The author/s, editor/s and publisher have attempted to trace and acknowledge the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgements to publish in this form have not been taken. If any copyright material has not been acknowledged please write and let us know so we may rectify it, in subsequent reprints.

Trademark notice: Presentations, logos (the way they are written/presented), in this book are under the trademarks of the publisher and hence, if copied/resembled the copier will be prosecuted under the law.

Composed, Designed and Printed in India

Contents

<i>Foreword — Prof. (Dr.) A.K. Srivastava</i>	<i>vii</i>
<i>Foreword — Prof. V.B. Singh</i>	<i>ix</i>
<i>Preface</i>	<i>xi</i>
<i>Introduction</i>	<i>xxv</i>

Part I: Manufacturing of Dairy Products

1. Fat-Rich Dairy Products	1
1.1. Malai	2
1.2. Cream	3
1.2.1. Coffee cream	4
1.2.2. Whipping cream	7
1.2.3. Plastic cream	11
1.2.4. Cultured cream	12
1.2.5. Frozen cream	13
1.3. Butter	14
1.3.1. Definition and classification	15
1.3.2. Composition	17
1.3.3. Buttermaking	18
1.3.3.1. Creamery butter	19
1.3.3.1.1 Polymorphism	27
1.3.4. Butter churn	29
1.3.5. Churning process	31
1.3.6. Continuous butter manufacture	37
1.3.7. Cooking butter	39
1.3.8. <i>Desi</i> butter	39
1.3.9. Microstructure of butter	41

1.3.10. Macroscopic properties of butter	43
1.3.11. Setting of butter	46
1.3.12. Over-run	48
1.3.13. Theories of churning	49
1.3.14. Packaging	51
1.3.15. Grading of butter	55
1.4. Ghee	60
1.4.1. Composition	62
1.4.2. Nutritive and therapeutic value	63
1.4.3. Digestibility and absorption	65
1.4.4. Milk fat and coronary heart diseases (CHD)	66
1.4.5. Standards of ghee	68
1.4.6. Methods of manufacture of ghee	70
1.4.6.1. Indigenous (<i>desi</i>) method	71
1.4.6.2. Direct cream method	72
1.4.6.3. Creamery butter method	73
1.4.6.4. Pre-stratification method	74
1.4.6.5. Continuous method	75
1.4.6.6. Cream de-emulsification method	76
1.4.7. Quality of ghee	78
1.4.8. Ghee residue	87
1.5. Butteroil (Anhydrous Milk Fat)	91
1.6. Low-fat Spreads	93
References	104
2. Fermented Dairy Products	105
2.1. The Story of Fermentation	105
2.2. Milk Fermentation	107
2.3. Definition and Classification	108
2.4. Manufacture of Cultured Dairy Products	110
2.4.1. Dahi	111
2.4.2. Mishti dahi	114
2.4.3. Shrikhand	117
2.4.4. Yoghurt	121
2.4.5. Lassi	132

2.4.6. Cultured buttermilk	136
2.4.7. Acidophilus milk	137
2.4.8. Kefir	137
2.4.9. Kumiss	138
2.4.10. Health effects of fermented milks	139
2.4.10.1. Management of cardiovascular diseases (CVD)	144
2.4.10.2. Anticancer effects	146
2.4.10.3. Effect on immunological function	148
References	150
3. Starter Cultures	153
3.1. Types of Starter Cultures	154
3.2. Characteristics of A Good Starter Culture	155
3.3. Factors Affecting the Behaviour of Starter Culture	156
3.4. Bacteriophages	160
3.5. Preparation of Starter Cultures	162
3.6. Maintenance and Preservation of Starter Cultures	166
3.7. Direct-Vat-Set Cultures	166
3.8. Preparation of Cultures Under Aseptic Conditions	168
References	169
4. Cheese Technology	171
4.1. Definition of Cheese	172
4.2. Classification of Cheese	173
4.3. Composition	174
4.4. Nutritional and Therapeutic Value	175
4.5. Principle of Cheese Manufacture	175
4.6. Outline of Cheese Manufacture	176
4.6.1. Selection of milk	177
4.6.2. Heat treatment of milk	179
4.6.3. Ripening of milk (Acidification)	180
4.6.4. Coagulation of milk	182
4.6.5. Post- coagulation processing operations	185
4.6.6. Treatment of rind	191
4.6.7. Salting	192

4.6.8. Packaging	198
4.6.9. Ripening of cheese	204
4.7. Fresh-Acid Curd Cheese	214
4.7.1. Cottage cheese	217
4.7.2. Cream cheese	223
4.7.3. Quark	224
4.7.4. Queso blanco or hispanic cheeses	226
4.7.5. Ricotta cheeses	226
4.7.6. Pasta-filata cheeses	227
4.7.6.1. Mozzarella cheese	227
4.7.7. The heat-acid coagulated Indian products	232
4.7.7.1. Paneer	233
4.7.7.2. Chhana	240
4.7.7.2.1. Chhana-based sweets	247
4.7.7.2.1.1. Rasogolla	247
4.7.7.2.1.2. Sandesh	249
4.7.7.2.1.3. Rasmalai	251
4.7.7.2.1.4. Chhana-murki	251
4.7.8. Rennets and coagulants	252
4.8. Cheddar-Type Cheeses	254
4.9. Swiss-Type Cheeses	264
4.10. Dutch-type Cheeses	270
4.11. Hard Italian Cheeses	276
4.11.1. Grana cheese	276
4.11.2. Romano cheese	277
4.12. Smear-Ripened Cheeses	278
4.13. Mould Ripened Cheeses	280
4.14. Cheeses Matured in Brine	284
4.14.1. Feta cheese	285
4.14.2. Domiati cheese	286
4.15. Technology of Buffalo Milk Cheeses	287
4.15.1. Optimization of technology for cheddar cheese manufacture	288
4.16. Pasteurized Processed Cheese Products	294
4.16.1. Manufacture of processed cheese products	298

4.17. Mechanization and Automation in Cheese Manufacture	304
4.18. Production and Marketing of Cheese – A Global Perspective	308
4.18.1. Historical development of cheese manufacture in India	311
4.18.2. Marketing of cheese	312
References	314
5. Heat Desiccated Products	317
5.1. Khoa	318
5.2. Rabri	335
5.3. Basundi	338
5.4. Khoa-based Sweets	342
5.4.1. Burfi	343
5.4.2. Peda	347
5.4.3. Kalakand	350
5.4.4. Milk cake	352
5.4.5. Kunda	353
5.4.6. Gulabjamun	354
5.4.7. Kalajamun	355
5.4.8. Pantua	355
5.4.9. Dry gulabjamun mix	356
5.4.10. Defects in khoa-based sweets	357
References	360
6. Concentrated Milks	363
6.1. Definition, Composition and Standards	364
6.2. Evaporated Milk	367
6.2.1. Evaporator	369
6.2.2. Method of manufacturing of evaporated milk	378
6.2.3. Physicochemical defects	387
6.3. Sweetened Condensed Milk	389
6.3.1. Manufacturing of sweetened condensed milk	390
6.3.2. Quality control	396
References	399

7. Drying of Milk and Milk Products	401
7.1. Definition, Classification and Composition of Dried Milks	402
7.2. Manufacturing of Milk Powder	406
7.2.1. Spray drying	409
7.2.1.1. Classification of spray dryers	410
7.2.1.2. Mixing of spray and drying air	417
7.2.1.3. Separation of the product from the drying air	420
7.2.2. Fluid Bed Drying/Cooling	427
7.2.3. Roller Drying	435
7.2.4. Foam Spray Drying	438
7.2.5. Production of Modified Milk Powder	439
7.2.5.1. Infant formulae	441
7.2.5.2. Foods for special medical purposes	449
7.2.5.3. Malted milk foods	451
7.2.5.4. Dairy whitener	452
7.2.5.5. Packaging, Storage, Quality Attributes and Common Defects of Dried	454
References	466
8. Ice Cream and Frozen Dessert	467
8.1. Definition and Composition	468
8.2. Classification	476
8.3. Manufacturing of Ice Cream	484
8.3.1. Ingredients	485
8.3.2. Preparation of ice cream mix	491
8.3.2.1. Calculation of ice cream mix ingredients	492
8.3.2.2. Ice cream mix processing	496
8.3.2.3. Overrun in ice cream	507
8.3.4. Hardening and storage	510
8.3.5. Common defects	513
References	519
9. Dairy Byproducts	521
9.1. Skim Milk	522
9.1.1. Casein and caseinates	522

9.1.1.1. Manufacturing process	525
9.1.1.1.1. Acid casein	525
9.1.1.1.2. Caseinates	531
9.1.1.1.3. Total milk protein (TMT)	538
9.1.1.1.4. Milk protein concentrate (MPC)	539
9.1.1.1.5. Milk protein hydrolysates	539
9.1.1.1.6. Uses of casein and caseinates	541
9.2. Buttermilk	549
9.2.1. Processing and drying of buttermilk.....	551
9.2.2. Utilization of buttermilk in dairy and food industry	551
9.3. Whey	553
9.3.1. Whey utilization	555
9.3.2. Whey processing.....	556
9.3.2.1. Fractionation of total solids	558
9.3.2.2. Protein recovery by UF	559
9.3.2.3. Bio-processing of whey for preparation of products of industrial importance.....	568
9.3.2.4. Nutritional and nutraceutical aspects of whey utilization .	570
9.3.3. Functional properties of milk proteins	571
References.....	575
10. Functional Dairy Foods	577
10.1. Technological Developments.....	578
10.2. Categories of Functional Foods	581
10.3. Milk and Milk Products as Functional Foods	584
10.4. Some Functional Dairy Products Available in the World Market	595
References.....	606
11. Cleaning and Sanitation	613
11.1. Cleaning Process	615
11.2. Characteristics of Good Dairy Cleaner	621
11.3. Cleaning Steps	628
11.4. Cleaning Methods	629
11.5. Formulation of Detergent Mixes	635
11.6. Sanitizing Process	636

Part II: Quality Assurance

12. Quality Assurance	647
12.1. Definition and Components of Food Quality	648
12.1.1. Food safety	649
12.1.2. Nutritional value	652
12.1.3. Sensory characteristics	652
12.2. Quality Aspects of Milk and Milk Products	655
12.3. Quality Control Tasks in Dairy Industry	657
12.4. Current Regulatory Provisions	658
12.5. International Food Laws and Their Implications to the Indian Dairy Industry	659
12.6. Codex Regulations and Codex Alimentarius Commission	661
12.7. Quality Control Management System (QCMS)	662
12.8. Prerequisite Programmes - Good Hygienic Practices (GHP)	664
12.9. Prerequisite Programme – Good Manufacturing Practices (GMP)	666
12.10. Quality Management Systems - ISO 9000	670
12.11. Food Safety Management Systems	674
12.11.1. Hazard Analysis and Critical Control Point (HACCP)	674
12.11.2. Environment Management System – ISO: 14000	679
12.11.3. Food Safety Management System – ISO 22000	679
12.12. Total Quality Management (TQM)	680
References	683



DAIRY TECHNOLOGY

Dairy Products & Quality Assurance

Dairy Technology is the industrial, non-farm phase of the tremendously large, dynamic and complex dairy industry. This phase represents a combination of science, engineering, business, and art as applied to all dairy and dairy-type foods and their industries. Dairy and dairy-type foods represent a major segment of the vast and varied food industry.

This comprehensive book has been written encompassing entire gamuts of manufacture of dairy products, functional foods, utilization of dairy byproducts, cleaning and sanitization and quality assurance.

The main objective of the book is to provide the latest information in a consolidated form at one point to meet the requirements of not only undergraduate and postgraduates students but also teachers and dairy professionals.

CONTENTS

Part I: Manufacturing of Dairy Products

- Fat-Rich Dairy Products
- Fermented Dairy Products
- Starter Cultures
- Cheese Technology
- Heat Desiccated Products
- Concentrated Milks
- Drying of Milk and Milk Products
- Ice Cream and Frozen Dessert
- Dairy Byproducts
- Functional Dairy Foods
- Cleaning and Sanitation

Part II: Quality Assurance

- Quality Assurance

Readership: The book will serve not only as the textbook but also as a reference on Dairy Technology for students, teachers and a complete handbook for the entire dairy industry. This book will prove to be very useful not only to the academic community but also to the researchers, planners, plant managers and extension workers.

Shivashraya Singh

Former Joint Director-cum-Dean and Emeritus Scientist, National Dairy Research Institute (NDRI), Karnal-132001, Haryana, India.

President of Dairy Technology Society of India located at the National Dairy Research Institute, Karnal - 132 001, Haryana, India



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, L.S.C. Market
Pitam Pura, New Delhi-110 034, India
Tel. : +91(11) 27341717, Fax : +91(11) 27341616
E-mail : info@nipabooks.com
Web : www.nipabooks.com

ISBN 978-93-83305-09-4



9 789383 305094